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(54) WIRELESS NETWORKITS PATH CONTROL METHOD AND WIRELESS COMMUNICATION CONTROLLER

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance the performance and the reliability of a wireless network by stably transferring data in the wireless network whose channel quality changes every moment.
SOLUTION: In the wireless network adopting a logical configuration where transfer paths are in existence among a plurality of wireless communication controllers in the case of transferring data from an optical sender to an optical destinationa control section 200 of a wireless communication controller being the sender transmits a path investigation frame to paths leading to the destination prior to start of transmission and discriminates paths such as those received earlier by the destinationpaths with less retrial number of times or paths with a small channel load to decide the path to be used for the transmission. The wireless communication controllers acting like relay stations in each path obtain number of retrial times/channel load of its own and apply update processing to the path investigation frame and store the result. Moreoverthe wireless communication controller acting like the destination acquires path information (retrial times/channel load) on the way by data frames during communicationdetects a fault when a value of the path information received by the destination exceeds a value stored in a threshold value storage section 211and informs the sender about the occurrence of the fault in the path in use to allow the sender to select other path.

CLAIMS

[Claim(s)]

[Claim 1]In a wireless network constituted among two or more communication control units with a wireless communication function so that two or more courses which transmit data to another communication control unit which serves as a transmission destination from a communication control unit which becomes a transmitting agency may existA frame which can investigate channel information is transmitted to said transmission destination from said transmitting originA wireless network which provides a transfer path control facility which determines a course in which line quality is the highest as a use course in a course or two or more courses which line quality by channel information acquired through this frame becomes more than a constant leveland is characterized by things.

[Claim 2]Hour corresponding of said frame in one way or a course of a round trip which said channel information transmits said frame to said transmission destination from said transmitting origin in claim 1A wireless network which is retry time or circuit load and is characterized by evaluating said line quality highlyso that a value of said channel information is small.

[Claim 3]In claim 1 or 2an issuing means of a frame which said communication control unit can investigate [of said channel information]A wireless network which is provided with a course judging means which determines a use course based on received channel informationconstitutes said transfer path control facility by link of a communication control unit of said transmitting origin and said transmission destinationand also a communication control unit of relayand is characterized by things.

[Claim 4]In a wireless network constituted so that two or more courses which transmit data to another communication control unit which serves as a transmission destination from a communication control unit which becomes a transmitting agency via direct or other communication control units among two or more communication control units with a wireless communication function may existDuring communication to said transmission destinationchannel information on a course is acquired from said transmitting origin using channel information area established in a data frame from a transmitting agencyA wireless network provided with a circuit malfunction detection function which compares a malfunction detection threshold with a value of channel information area in said transmission destinationperforms malfunction detection of a course under communication when a value of said channel information exceeds said malfunction detection valueand notifies an abnormal occurrence to said transmitting origin.

[Claim 5]When the transfer path control facility according to claim 12or 3 is provided and said transmitting origin gets to know an abnormal occurrence of a use course in claim 4A wireless network having transmitted at least a frame which can investigate said channel information to said transmission destination through other courses of all the besides a use courseand enabling a change for a good

course of route quality.
[Claim 6]In a path control method of a wireless network constituted among two or more communication control units with a wireless communication function so that two or more courses which transmit data to another communication control unit which serves as a transmission destination from a communication control unit which becomes a transmitting agency may existAt the time of a communication start to said transmission destination from said transmitting originor resumptiona course investigation frame for investigating channel information to all the courses from said transmitting origin to said transmission destination is transmittedA path control method of a wireless network judging line quality of each course and determining a use course based on channel information of two or more course investigation frames which said transmission destination receivedor channel information of two or more course investigation frames which said transmitting origin received by return [course / each] in said transmission destination.
[Claim 7]A path control method of a wireless network judging a course in which said said transmission destination or transmitting origin received said course investigation frameand was first received from two or more courses in claim 6 to be a course of the shortest best line quality of hour corresponding.
[Claim 8]In claim 6it has a field which stores retry time as said channel information in said course investigation frameRetry time generated when a communication control unit which relays a course investigation frame from said transmitting origin to said transmission destination or a course investigation frame of a clinch transmitted said course investigation frame to a communication control unit of the next step is accumulated to a field which stores retry time in said course investigation frameA path control method of a wireless networkwherein said said transmission destination or transmitting origin measures retry time in a course investigation frame received from two or more courses and judges the smallest course of accumulated of retry time to be a course of the best line quality.
[Claim 9]In claim 6it has a field which stores circuit load in said course investigation frameWhen a communication control unit which relays a course investigation frame from said transmitting origin to said transmission destination or a course investigation frame of a clinch transmits said course investigation frame to a communication control unit of the next stepit asks for the present circuit loadIt rewrites to circuit load which asked for circuit load in a course investigation frame when circuit load for which it asked from a value of circuit load stored in said course investigation frame was largeA path control method of a wireless networkwherein said said transmission destination or transmitting origin compares circuit load in a course investigation frame received from two or more courses and judges the smallest course of circuit load to be a course of the best line quality.
[Claim 10]A path control method of a wireless network characterized by what said circuit load expresses in claim 9 with a value which broke the number of bits of a frame transmitted and received from this time to even before predetermined time between communication control units of said next step by a zone of a circuit between communication control units of said next step.

[Claim 11]Are a wireless network one of two or more of the communication control units to constituteand A transmitting stationIn a radiocommunication control device with a wireless communication function which serves as a receiving station or a relay stationand transmits data from a transmitting agency (transmitting station) to a transmission destination (receiving station) using one of two or more of the coursesHave channel information area and A transmitting means of a frame which can acquire channel information from said transmitting origin to said transmission destinationA channel information acquisition means which updates channel information of a received frame based on channel information searched for with a self-deviceA radiocommunication control device performing at least one of a transmitting means which a course judging means which determines a use course based on channel information of a frame received from two or more courses was establishedand a self-device responded for whether being a transmitting stationa receiving stationor a relay stationand was mentioned abovea channel information acquisition meansor the course judging means.

[Claim 12]A radiocommunication control device comprising:

It is said channel information area to a data frame which transmits to said transmission destination from said transmitting origin in claim 11.

A malfunction detection means to perform malfunction detection of said use course as compared with a malfunction detection threshold which acquires channel information of a use course from said data frameand is beforehand set up during data communications when a value of channel information of a use course exceeds a threshold.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates especially to the path control method of a radiocommunication control device about the wireless network which comprises two or more radiocommunication control devices.

[0002]

[Description of the Prior Art]In recent yearsit does not remain between computers by progress of the computer network which exchanges data only at the contractor who is performing communications service businessbut has spread through the data communications in a company and between a companyetc. The demand of introduction of network communication has spread in the small-scale officethe supermarketthe ordinary homeetc. Howeverthe wired system which performs interconnection of the computer according [old network technology] to a cable is a subjectIt was difficult for arrangement of a computer to introduce a network frequently like a supermarket in the ordinary home and small-scale office of a

variable field place or the cable itself where construction is difficult.
[0003]As a method of solving the problem of these cable layingthe network by not a cable but radio attracts attention. It is necessary to establish communication between adjoining specific radio stations for wireless network construction. For exampleeach radio station can perform communication with a specific radio station by dividing a zone by the pattern which was able to be decided beforehand with the frequency hopping method provided in international standard IEEE802.11. That issince communication is materialized only between the radio stations where a frequency hopping pattern is the samecommunication between other radio stations is not received accidentally.
[0004]After securing the communication line of only an adjacent station with a specific radio stationit opts for the composition of a logical network based on SSID (system ID number) assigned by each radio station. Since a logical network network is only constituted in this stagetwo or more network paths between the radio stations through the relay of the radio station existand the program of a higher rank performs further which course is chosen rather than the program which constituted the logical network network.
[0005]A general method zone shared [in a wireless network] is a CSMA/CA method. This method is the method of performing carrier sensingchecking no radio station taking out data (transmission wave)and performing data transmission as it is indicated to standard IEEE802.11. When the transmission wave of two or more radio stations collides and data does not reach a distant officein order not to return a response to the data in which the distant office was transmittedas for a transmitting stationthe time to response reception is timing outand a transmitting station detects the collision of a transmission waveor un-reaching of the transmission wave by disturbance.
[0006]
[Problem(s) to be Solved by the Invention]Since cable laying of a wireless network is unnecessaryit is used for the composition of the network whose distance between computers it is small-scale and is short until now. Howeverapplication of the wireless network is called for also about the large-scale trunk network with which only the wired network was realized until now.
[0007]Howeverthe communication environment by a wireless networkVarious disturbance factors which emit thru/or reflect not only other nearby radio communication equipments but an electric wave existand there is the feature which is not in a wired network that line quality changes with the passage of timeby change which the environment which transmits and receives an electric wave carried out every moment. For this reasoncompared with a cablethe occurrence frequency of communication failure is highand a bit error rate is high from 10 times to about 100 times. The communication line determined once may also become unusual while in useand communication may be stopped. On the other handthe feature that line quality is restored promptly also has the abnormalities in radio while it is transient in many cases and time passes.
[0008]When two or more sets of radio communication equipments communicate

mutuallyin order to have to share a zoneit is the point that the throughput of data transfer falls. Since a zone is shared so that mutual communication may not be blocked when two or more wireless networks exist and it uses the same frequency bandit may communicate by time sharingfor example using a zone.
Thereforeexistence of two or more wireless networks which communicate will reduce the throughput of data transfer only the number of the networks. Even when two or more wireless networks are mutually separated and there is usually no influence mutuallymutual radio is received temporarily and the state where a zone must be shared may occur. In order to construct the cable for each networkstwo or more networks do not share a zone between a wired network.
[0009]That isin a wireless networksince the part to which the throughput of data transfer falls occurs frequently or data transfer is temporarily impossibledata transfer cannot be performed stably. And when data transfer is not stabilizeda packet (frame) loss occursresending with a higher-level protocol or frame resending between relay appliances occurs frequentlyand a transit delay becomes large. Such a thing serves as restrictions when applying a wireless network to a trunk-line data service network with long large-scale and data-communications distance.
[0010]The purpose of this invention is a data transmission line control system of the wireless network which secures the performance and reliability of data transfer and makes stable data transfer possibleand to realize wireless network-ization of a large-scale trunk-line data service network in view of the problem of the above-mentioned conventional technology.
[0011]
[Means for Solving the Problem]In order to attain the above-mentioned purposethis invention among two or more communication control units with a wireless communication functionIn a wireless network constituted so that two or more courses which transmit data to another communication control unit which serves as a transmission destination from a communication control unit which becomes a transmitting agency may existA frame which can investigate channel information is transmitted to said transmission destination from said transmitting originA transfer path control facility which determines a course in which line quality is the highest as a use course in a course or two or more courses which line quality by channel information acquired through this frame becomes more than a constant level is provided.
[0012]Said line quality is evaluated highlyso that said channel information is hour correspondingretry timeor circuit load of said frame in one way which transmits said frame to said transmission destination from said transmitting originor a course of a round trip and a value of said channel information is small.
[0013]Said communication control unit is provided with an issuing means of a frame which can investigate said channel informationand a course judging means which determines a use course based on received channel informationandas for a transmitting agencysaid transfer path control facility is realized by composition linked as a transmission destination or a relay station.

[0014]In a wireless network constituted so that two or more courses which transmit data to another communication control unit which serves as a transmission destination from a communication control unit which becomes a transmitting agency via direct or other communication control units among two or more communication control units in which this invention has a wireless communication function may existDuring communication to said transmission destinationchannel information on a course is acquired from said transmitting origin using channel information area established in a data frame from a transmitting agencyA malfunction detection threshold was compared with a value of channel information area in said transmission destinationmalfunction detection of a course under communication when a value of said channel information exceeds said malfunction detection value was performedand it had a circuit malfunction detection function which notifies an abnormal occurrence to said transmitting origin.

[0015]When said transfer path control facility was provided and said transmitting origin got to know an abnormal occurrence of a use coursea frame which can investigate said channel information was transmitted to said transmission destination through other courses of all the besides a use course at leastand a change for a good course of said route quality was enabled.

[0016]A path control method of a wireless network of this inventionIn a wireless network constituted among two or more communication control units with a wireless communication function so that two or more courses which transmit data to another communication control unit which serves as a transmission destination from a communication control unit which becomes a transmitting agency may existAt the time of a communication start to said transmission destination from said transmitting originor resumptiona course investigation frame for investigating channel information to all the courses from said transmitting origin to said transmission destination is transmittedBased on channel information of a course investigation frame of two or more courses which said transmission destination receivedor channel information of two or more course investigation frames which said transmitting origin received by return [course / each] in said transmission destinationline quality of each course is judged and a use course is determined.

[0017]Said said transmission destination or transmitting origin judges a course which received said course investigation frame and was first received from two or more courses to be a course of the shortest best line quality of hour corresponding.

[0018]It has a field which stores retry time as said channel information in said course investigation frameRetry time generated when a communication control unit which relays a course investigation frame from said transmitting origin to said transmission destination or a course investigation frame of a clinch transmitted said course investigation frame to a communication control unit of the next step is accumulated to a field which stores retry time in said course investigation frameSaid said transmission destination or transmitting origin measures retry time in a course investigation frame received from two or more coursesand judges the

smallest course of accumulated of retry time to be a course of the best line quality.
[0019]Have a field which stores circuit load in said course investigation frameand when a communication control unit which relays a course investigation frame to said transmission destination or a course investigation frame of a clinch from said transmitting origin transmits said course investigation frame to a communication control unit of the next stepit asks for the present circuit loadIt rewrites to circuit load which asked for circuit load in a course investigation frame when circuit load for which it asked from a value of circuit load stored in said course investigation frame was largeSaid said transmission destination or transmitting origin compares circuit load in a course investigation frame received from two or more coursesand judges the smallest course of circuit load to be a course of the best line quality.
[0020]Said circuit load expresses a communication control unit of said next stepand the number of bits of a frame transmitted and received even before predetermined time from this time with a value broken by a zone of a circuit between communication control units of said next step.
[0021]A radiocommunication control device of this invention is one of two or more of the communication control units which constitute a wireless networkIt has a wireless communication function which serves as a transmitting stationa receiving stationor a relay stationand transmits data from a transmitting agency (transmitting station) to a transmission destination (receiving station) using one of two or more of the coursesHave channel information area and A transmitting means of a frame which can acquire channel information of a course from said transmitting origin to said transmission destinationA channel information acquisition means which updates channel information of a received frame based on channel information searched for with a self-deviceA course judging means which determines a use course based on channel information of a frame received from two or more courses is establisheda self-device responds for whether being a transmitting stationa receiving stationor a relay stationand at least one of each of the above-mentioned means is performed.
[0022]Have said channel information area in a data frame which transmits to said transmission destination from said transmitting originand channel information of a use course is acquired from said data frame during data communicationsAs compared with a malfunction detection threshold set up beforehandwhen a value of channel information of a use course exceeded a thresholda malfunction detection means to perform malfunction detection of said use course was formed.
[0023]According to this inventiondeterioration of line quality transient on a wireless network occurs between each radio communication equipmentWhen data transfer became late temporarily or a course which cannot perform the data transfer itself occursTime which data transfer takes to a communication control unit of data transmission originor a communication control unit of the data transmission pointdata transfer retry time between radio communication equipments. Or deterioration of line quality is detected from circuit load between radio communication equipmentsby changing data transfer to a course to which

line quality is not falling from a course to which line quality fella data transfer path is secured and data communications are continued.
[0024]Since performance of data transfer and reliability are securable by securing a data transfer pathstable data transfer is realizable in a wireless network.
[0025]
[Embodiment of the Invention]Hereaftertwo or more embodiments are described about the wireless network by this inventionand its transfer path control system. A 1st embodiment explains the transfer path control system held when starting transmission in the wireless network between a transmitting agency and a transmission destination. A 2nd embodiment explains the surveillance of a transfer path performed in the wireless network between the transmitting origin under transmissionand a transmission destinationand a control system.
[0026][A 1st embodiment] Drawing 2 shows one example of the wireless network which applies this invention. This wireless network serves as the radiocommunication control devices 100 and 110120130140 from the radio terminals 101 and 102 and 103121122123 gradesand constitutes the wireless network of ring shape. On account of explanationalthough only the radio terminal linked to the radiocommunication control device 100120 is shownthe same radio terminal as other radiocommunication control devices is connected.
[0027]Since the network of ring shape is constitutedcommunication of each radiocommunication control device has become possible with other two radio communication equipments like the arrow of a graphic display. For examplethe radiocommunication control device 110140 and communication are possible for the radiocommunication control device 100 by course ** and **. By the radio communication equipment 110130 and course **the data transfer with the radiocommunication control device 120 whose direct communication is impossible relays the radio communication equipment 140and is performed at course **. The same may be said of the case of other radio communication equipments. The circuit malfunction detection threshold storage part 211 will have memorized the threshold which shows whether it detects as a circuit being unusualif retry time or circuit load becomes a value of whichand it is referred to in the operation of Embodiment 2 mentioned later.
[0028]Drawing 1 shows the composition of the radiocommunication control device by one example of this invention. The radiocommunication control device 100 The control section 200the timer 201the demodulator 202the band pass filter 203the receiving mixer 204the frequency synthesizer 205the transmission mixer 206the modulator 207the transceiver buffer 208the antenna 209the transceiver changeover switch 210It comprises the circuit malfunction detection threshold storage part 211. Other radio communication equipments are the same.
[0029]While the control section 200 of the radiocommunication control device 100 manages the whole controlhereThe transmitting means of the frame which can acquire the channel information indicated to "The means for solving a technical problem"The function of the software mentioned later has realized the channel information acquisition means which updates the channel information of the frame

which computed the channel information in the self-device and was receivedand the course judging means which determines a use course based on the channel information of the frame received from two or more courses. The malfunction detection means concerning a 2nd embodiment is also the same.
[0030]Fundamental operation of the data transmission in the radiocommunication control device 100 is explained. The control section 200 generates the data frame containing a transmission destination addressa transmission source addressand dataand stores it in the transceiver buffer 208. At the time of transmissionthe control section 200 changes the transceiver changeover switch 210 to the output of the transmission mixer 206reads a data frame from the transceiver buffer 208and outputs it to the modulator 207. The data frame modulated with the modulator 207 is sent to the transmission mixer 206is put on the subcarrier which the frequency synthesizer 205 generatesand is transmitted to other radiocommunication control devices via the antenna 209. On the other handthe receiving mixer 204 receives and carries out the frequency modulation of the signal which aligns with the carrier frequency from the frequency synthesizer 205and restores to it to the data frame of digital data with the demodulator 202 through the band pass filter 203. The data frame of reception is sent to the control section 200and is stored in the transceiver buffer 208.
[0031]The composition of two or more data frames used for transmission and reception is shown in drawing 3. The frame of (a) comprises the preamble 300the transmission destination address 301the transmission source address 302the route 303the data 304and CRC(Cyclic Redundancy Code) 305. The route 303 is the field which shows the transfer path of this frameand shows either course [of drawing 2] **or course **. On the other handas for the frame of (b)it has the field of the circuit load 307the retry time 306 or the circuit load 307 in a circuit is transmittedand the field of the retry time 306 and the frame of (c) are stored in the transceiver buffer 208.
[0032]With the transfer path control system of a 1st embodimentthe frame of drawing 3 (a)(b)and (c) is applied to Example 1Example 2and Example 3 which are described belowrespectively.
[0033][Example 1] Example 1 of the transfer path control method is a method which determines the course in which a frame is most received early in two or more courses as a transfer pathand the example to which the radio terminal 101 transmits data to the radio terminal 123 explains it hereafter.
[0034]The radio terminal 101 transmits data to the radiocommunication control device 100. The radiocommunication control device 100 frame-izes the data from the radio terminal 101and transmits it to the radiocommunication control device 140 of course **or the radiocommunication control device 110 of course **. When the radiocommunication control device 110 receives a data framedata is transmitted to the radiocommunication control device 120. On the other handwhen the radiocommunication control device 140 receives a data framea data frame is transmitted to the radiocommunication control device 120 via the radiocommunication control device 130. The radiocommunication control device

120 which received the data frame recognizes that the data transfer point is the radio terminal 123and transmits the received data to the radio terminal 123.
[0035]A course investigation frame is transmitted and received using course ** and **and a decision of a transfer path is made when starting this data transmission between the radiocommunication control devices 120 used as the radiocommunication control device 100 which serves as the transmitting side (transmitting agency) in a wireless networkand a receiver (transmission destination). Herecourse ** has abnormalities like drawing 2and course ** explains a normal case. The course investigation frame to be used is the same format as the data frame of drawing 3 (a). Howeversince the data 304 just does the check of the normal reception in a reception destinationtest data may be sufficient.
[0036]Drawing 4 shows the flow of a communication frame in case a transmission destination determines a course in Example 1. The radiocommunication control device 120 of a transmission destination is used as a center sectionand the radiocommunication control device 100 of the transmitting agency is described to both ends so that it may be easy to compare the flow of the frame of both course ** and ** (actually one). The radiocommunication control device 100 transmits a course investigation frame to course ** on the right-hand side of a graphic displayand left-hand side course ** simultaneously.
[0037]The course investigation frame transmitted to course ** is received by the radiocommunication control device 140. The radiocommunication control device 140 checks whether the data of a course investigation frame has been correctly received using CRC305 in a frame. When received correctlya received response is returned to the radiocommunication control device 100 which is the transmitting side of the preceding paragraph. The check also with same radiocommunication control device 130 which relays a frame after the radiocommunication control device 140 and radiocommunication control device 120 which receives a frame eventually is performedand if a frame is righta received response will be returned to the radiocommunication control device of the preceding paragraph. By these proceduresa course investigation frame is received by the radiocommunication control device 120 through course **.
[0038]On the other handalthough the course investigation frame transmitted to course ** is transmitted to the radiocommunication control device 110 from the radiocommunication control device 100According to an electromagnetic interference etc.the circuit between the radiocommunication control devices 100 and 110 cannot receive the radiocommunication control device 110 correctlyand cannot return a received response to the radiocommunication control device 100. Although the radiocommunication control device 100 supervises the received response from the radiocommunication control device 110 with the timer 201 after investigation frame transmission and in a deviceit is timing out in order that a received response may not come back. Thenthe radiocommunication control device 100 retries transmission of the course investigation frame to the radiocommunication control device 110 (resending).
[0039]In the graphic displaythe radiocommunication control device 110 received

the course investigation frame correctly by the 2nd retryand the received response is returned to the radiocommunication control device 100. As a resultthe course investigation frame transmitted to course ** relays the radiocommunication control device 110and is received by the radiocommunication control device 120. Communication is interrupted when the maximum retry time appointed beforehand is exceeded.

[0040]The radiocommunication control device 120 of the transmission destination which received the course investigation frame will determine a course by which [three] following methods according to the composition of the course investigation frame to be usedif the course investigation frame from course ** and course ** is received. When using the course investigation frame of a format of drawing 3 (a)the radiocommunication control device 120 determines course ** which the course investigation frame previously received between two course investigation frames which passed course ** and course ** passed as a use course. And the course response frame which set course ** as the route 303 of a course frame is returned to the radiocommunication control device 100 of a transmitting agency via the radiocommunication control devices 130 and 140. The radiocommunication control device 100 sets course ** as the frame transmission course to the radiocommunication control device 120 from the channel information of a response frameand transmits a frame to the radiocommunication control device 120 via course **.

[0041]In this examplesince the course investigation frame was transmitted to the transmission destination in two courses from the transmitting agencythe course of the course investigation frame which the transmission destination received previously was determined as the transfer path and the course response frame has notified to the transmitting agencythe time in connection with the route determination of a wireless network can be shortened.

[0042]A transmission destination transmits the course response frame which turns up the same coursewithout determining a courseand may be made to determine the course of the course response frame which the transmitting agency received previously as a transfer path as modification of Example 1.

[0043]Drawing 5 shows the flow of a communication frame in case a transmitting agency determines a courseand is described in the same form as drawing 4. The radiocommunication control device 100 transmits a course investigation frame to course ** and course **. The course investigation frame transmitted to course ** and course ** reaches the radiocommunication control device 120 in the same procedure as the case of drawing 4. On the other handthe circuit between the radiocommunication control devices 100 and 110 is not correctly transmitted for the course investigation frame transmitted to course ** by the electromagnetic interferencebut a retry occurs.

[0044]The radiocommunication control device 120 which received the course investigation frame from course ** and course ** will return a course response frame to the course concerned by the same procedure by return at the radiocommunication control device 100if a course investigation frame is received.

The radiocommunication control device 100 determines the course set as the route 303 of the frame previously received among the course response frames which received from course ** and course ** as a transfer path. Generallythe route determination by a transmitting agency can improve reliability compared with the determination of a transmission destination. Howeverboth methods have each merits and demeritsand a detailed comparison is mentioned later.

[0045][Example 2] Example 2 of the transfer path control method is a method which determines a course with least retry time as a transfer path in two or more coursesand the example which transmits a course investigation frame to the radiocommunication control device 110 from the radiocommunication control device 100 explains it hereafter. It is applied to Example 2 and a course investigation frame is the same format as the frame of drawing 3 (b). That isit has the area of the retry time 306 which accumulates and stores the retry time of the course investigation frame which each radiocommunication control device performed by the time the course investigation frame was transmitted to the radiocommunication control device 120 from the radiocommunication control device 100.

[0046]The flow of transmitting processing of a radiocommunication control device including renewal of retry time is shown in drawing 7. This procedure is controlled by the control section 200. If a radiocommunication control device receives a course investigation frame from the radiocommunication control device of the preceding paragraph (s101)transmission destination address [in a course investigation frame] 401 and CRC305 will be checked (s102). a check of that it is not a course investigation frame addressed to itself from the transmission destination address 301 will transmit the course investigation frame received to the radiocommunication control device of the next step -- it carries out (s103). The received response from the radiocommunication control device of the next step is supervised with the timer 201 in a device after course investigation frame transmission (s104). When a received response comes back before timeout of the timer 201the send action of a course investigation frame is ended. Howeverwhen there is no received response and the timer 201 times outthe retry time 306 of a course investigation frame is readand 1 is added to the value (s105).

[0047]When a radiocommunication control device transmits a course investigation frame first0 is written in the retry time 306. If 1 is added to the retry time 306a course investigation frame will be again transmitted to the radiocommunication control device of the next step (s103). A retry is repeated until it becomes the retry time beforehand set as the circuit malfunction detection threshold part 211and it accumulates the value of the retry time 306 in a course investigation frame.

[0048]Drawing 6 shows the flow of a communication frame in case a transmission destination determines a course in Example 2. The value of the retry time 306 on the course investigation frame which passed course ** and was received with the radiocommunication control device 120 is set to 0and the value of the retry time 306 which passed course ** is set to 2. The radiocommunication control device

120 measures the retry time 306 of the course investigation frame which passed course ** and course **and determines course ** with a small value of the retry time 306 as the transfer path between the radiocommunication control device 100 and the radiocommunication control device 120. And a course response frame is transmitted to determined course **and it notifies to the radiocommunication control device 100.

[0049]Like a wireless networksince according to this the retry time between the radiocommunication control devices within a transfer path is accumulated and a course with few retries is chosenwhen there are many transient abnormalities in communicationa course with few abnormalities can be relatively chosen by **********and data transfer can be performed stably.

[0050]Also in Example 2the modification which is transmitting [not a transmission destination but] originand determines a transfer path is possible. That isa course response frame is transmitted to each of course ** and course ** from the radiocommunication control device 120and it is received by the radiocommunication control device 100. The retry time of a course response frame makes an initial value retry time accumulated with the course investigation frameand has the retry time generated in the course by return with each communication control unit accumulated. The radiocommunication control device 100 is determined as the transfer path which uses a direction with little retry time by the course response frame which received.

[0051]In the example shown in the flow of drawing 5since a retry does not occur in transmission of a course investigation frame and a course response frame at course **the value of the retry time 306 in the course response frame of course ** is 0. On the other handsince the retry time of 2 times and a course response frame of the retry time of the course investigation frame in course ** is 1 timethe value of the retry time 306 in a course ** course response frame is 3. As a resultthe radiocommunication control device 100 chooses course ** as a course between the radiocommunication control device 100 and the radiocommunication control device 120.

[0052][Example 3] Example 3 of the transfer path control method is a method which determines a course with least maximum of number-of-times load as a transfer path in two or more coursesand the example which transmits a course investigation frame to the radiocommunication control device 110 from the radiocommunication control device 100 explains it hereafter. It is applied to Example 3 and a course investigation frame is the same format as the frame of drawing 3 (c). That isby the time a course investigation frame is transmitted to the radiocommunication control device 120 from the radiocommunication control device 100each radiocommunication control device will compute the circuit load per unit timeand the area of the circuit load 307 of a course investigation frame is updated at the maximum.

[0053]The flow of transmitting processing of a radiocommunication control device including calculation of circuit load is shown in drawing 8. If a radiocommunication control device receives a course investigation frame from the preceding paragraph

(s201)transmission destination address [of a course investigation frame] 301 and CRC305 will be checked (s202). If it judges that the course investigation frame was normally received with the check of CRC503the present circuit load between the radiocommunication control devices of the next step will be computed (s203).
[0054]If an example of the calculating method of circuit load is giventhe radiocommunication control device of the next step for the past 1 second and the number of bits of the frame transmitted and receivedwill be broken by "the zone of the circuit between the radiocommunication control devices of the next step." For exampleload is set to 0.648 when the number of transmission bits to the radiocommunication control device of the next step [zone / of a circuit] for the past 1 second in 100 MBit(s)/sec is 64.8 Mbit/sec. This circuit load shows the degree of occupancy of a circuit bandand the zone which can originally be transmitted and received in 100 MBit(s)/sec can transmit only 64.8 Mbit/sec for a certain reason. That isa throughput fallsso that this circuit load value is low.
[0055]The value of the circuit load 307 in the received course investigation frame is compared with the value of the computed circuit load after calculation of circuit load (s204)When the computed load is largeit rewrites for the load which computed the value of the circuit load 307 in a course investigation frame (s205)and a course investigation frame is transmitted to the radiocommunication control device of the next step (s206). When the value of the circuit load 307 in a course investigation frame is larger than the computed loadthe value of the circuit load 307 in a course investigation frame is left as it isand transmits a course investigation frame to the radiocommunication control device of the next step.
[0056]The received response from the radiocommunication control device of the next step is supervised with the timer 201 in a radiocommunication control device after course investigation frame transmission (s207). When a received response comes back before timeout of the timer 201transmission of the course investigation frame to the radiocommunication control device of the next step is ended. On the other handwhen a received response is not received before timeout of the timer 201a course investigation frame is transmitted again. And it returns to Step s203 and load is calculated again. In load calculation hereit is previously carried out also including the number of transmission bits of the course investigation frame which transmitted to the radiocommunication control device of the next step. For this reasonsince the number of transmission bits unnecessary whenever transmission of a course investigation frame retries increasesthe value of load becomes large.
[0057]Load is calculated until the transmitting retry of a course investigation frame is successful as mentioned aboveand the value of the largest circuit load is written in the area of the circuit load 307 of a course investigation frame. In the course investigation frame transmitted to course ** and course ** in drawing 6the value of the circuit load 307 of the course investigation frame which passed course ** generally becomes small rather than the value of the circuit load 307 of the course investigation frame which passed course ** which the retry of a course investigation frame generates. At this timethe radiocommunication control device

120 compares the circuit load 307 of the course investigation frame which passed course ** and course **and judges course ** with a small value of the circuit load 307 to be a course between the radiocommunication control device 100 and the radiocommunication control device 120.

[0058]By the wayother wireless networks close to the wireless network of drawing 2 existSince data ** which can be transmitted and received by the ingress of the sending signal from other networks is restricted when the radiocommunication control device of other networks and the communication control unit of course ** share a communication bandthe throughput of the device concerned falls only the part. According to comparison of the circuit load of this exampleit includes also to a load change peculiar to such radioand channel selection with more sufficient processing efficiency becomes possible.

[0059]Also in Example 3the modification which is a transmitting agency and determines a transfer path is possible. That isa course response frame is transmitted to each of course ** and course ** from the radiocommunication control device 120and it is received by the radiocommunication control device 100. At this timethe circuit load 307 of a course response frame makes the value in a course investigation frame an initial valueis calculated by each communication control unit of a clinch courseis compared with circuit loadand is updated by the maximum.

[0060]In the example shown in the flow of drawing 5since the retry time of course ** and course ** will be 0 times and 3 timesrespectivelysupposing other factors cannot be foundthe load of course ** will become largeand course ** with small load is determined as a transfer path.

[0061]In the aboveExamples 1-3 explained the route determination method at the time of the data-communications start in a wireless network. Example 1 has the shortest processing time of circuit determination. Only the part which accumulates retry time can reflect more correctly the circuit condition of the wireless network which transient abnormalities tend to generate although processing time becomes longand reliability of Example 2 improves. Example 3 becomes the longest [processing time] by calculation of circuit loadmaximum judgingetc. Howeversince circuit conditions peculiar to a wireless networksuch as retry time and a confusion situation of a zoneare reflected in circuit load and abnormalities can choose few [and] high transfer paths of a throughput mostthere are few the circuit discontinuation and throughput falls under communicationand it is reliable.

[0062]**** for a format common to a course investigation frame in each of the above-mentioned examples -- things are also possible. That isthe area of an investigation parameter is provided in a frame and retry time or circuit load is stored according to the parameter of a control program. In the case of Example 1it becomes a straw man.

[0063]Nextthe feature with the case where it determines in the case where are a transmitting agency and a transfer path is determinedand a transmission destination is explained. Since a circuit condition is reflected through the round trip of a coursethe reliability of route determination becomes highbut the method

of being a transmitting agency and generally determining has the still more nearly following advantages and disadvantages.
[0064]Since the transmitting agency can define the course investigation frame number which transmits beforehand when determining a transmitting agencythe maximum of the number of course response frames replied is also known. On the other handwhen determining in a transmission destinationthere is no telling which has a course investigation frame number to receive. For this reasonit is necessary to have a float for becoming final and conclusive the timing which performs course comparisonand sufficient margin for the data storage field for comparison in Examples 2 and 3. Thereforethe direction which a transmitting agency determines can make memory storage small.
[0065]Since a course frame is replied only to the determined course on the other hand when determining a receiver to a course frame going and coming back to each course one time when determining a transmitting agencyit becomes only one circuit used at the time of a reply. For this reasonthere can be little amount of the circuit used of a course investigation frameand can endand a direction when a receiver judges can make circuit load small.
[0066][A 2nd embodiment] Nextthe surveillance of a transfer path performed in the wireless network between the transmitting origin under transmission and a transmission destination and a control system are explained as a 2nd embodiment of this invention. The 2nd radiocommunication control device and wireless network in an embodiment are the same as drawing 1drawing 2etc. which were used for explanation of a 1st embodiment.
[0067]According to a 2nd embodimentthe retry time or circuit load stored in the data frame under communication is supervisedand when they exceed a malfunction detection thresholdmalfunction detection is performed as the omen of the abnormalities in a circuit thru/or generating. When malfunction detection is carried outthe same course investigation frame as Embodiment 1 is publishedand the transfer path to be used is re-determined.
[0068]The wireless network which produced the abnormalities in a circuit during communication is shown in drawing 9. Network composition is the same as drawing 2. In the state of drawing 2course ** between the radiocommunication control device 100 and the radiocommunication control device 110 is unusualcourse ** is chosen as the transfer path of a frameand data communications are performed. From this stateit recovers and the abnormalities in a circuit of course ** presuppose that the circuit between the radiocommunication control device 130 and the radiocommunication control device 140 newly became unusual. It becomes impossible in this casefor course ** which is a frame transfer path between the radiocommunication control device 100 and the radiocommunication control device 120 to transmit a frame normally.
[0069]The flow of the frame of course ** which abnormalities generated during communication is shown in drawing 10. Since the circuit between the radiocommunication control device 130 and the radiocommunication control device 140 is unstablea retry occurs at the time of transmission of the response frame to

a data frame and a data frame. According to this embodimentthe format of drawing 3 (b) or (c) is used for a data framethe retry time 306 or circuit load 307 is supervisedand the abnormalities in a course of a circuit in use are detected.
[0070]That isthe data frame which stored the retry time 306 or the circuit load 307 is transmitted to the radiocommunication control device 120 from the radiocommunication control device 100 in the procedure shown by course ** of drawing 6. The radiocommunication control device 120 which received the data frame reads the retry time 306 or the circuit load 307 in a data frameWhen the value judges whether it has become beyond the threshold (it changes to the "comparison test" in the transmission destination of drawing 6and "abnormality judgement" is performed) and is over the thresholdthe course response frame which abnormalities regard it as generating thru/or an omen to course **and tells the radiocommunication control device 100 about the abnormalities in a circuit is transmitted. The numerical value of the retry time 306 or the circuit load 307 is made into the specific value which shows an abnormal occurrenceand the notice of the abnormalities in a circuit returns itfor example.
[0071]As for a thresholdretry time or a circuit load value is set as the circuit malfunction detection threshold storage part 211 of drawing 1. communication is interrupted -- it is somewhat desirable to beto carry out and to make the level of an omen into a threshold with a front unusual circuit.
[0072]It is a transmitting agency and may be made to perform detection of the abnormalities in a circuit. The flow of the data frame at this time and a response frame is the same as the procedure shown in course ** of drawing 5. When in course ** the radiocommunication control device 100 reads the retry time 306 in a course response frameor the value of the circuit load 307 and the value is over the thresholdit detects that abnormalities occurred in course **.
[0073]With a transmission destination or a self-deviceif the abnormalities in a circuit of a course in use are detectedthe radiocommunication control device 100 of a transmitting agencyCommunication is interrupted temporarilya course investigation frame is transmitted to course ** and **a normal course is investigated with the transfer path control system explained by a 1st embodimentandas a resultcourse ** is chosen. The radiocommunication control device 100 resumes the data communications interrupted temporarily using course **.
[0074]When the communication under execution has not carried out accident discontinuation yet at the time of detection of the abnormalities in a circuita course investigation frame is transmitted only to course ** which the radiocommunication control device 100 of a transmitting agency is not usingand it may be made to judge the propriety of the use. In the re-determination of the transfer path by the malfunction detection under communicationit is good for shortening processing time to a change most to be based on the technique of Example 1. Howeverwhen taking into consideration the reliability mentioned aboveit is good also by the technique of Example 2 or Example 3.
[0075]

[Effect of the Invention]Since according to this invention a circuit state is investigated about two or more courses from a transmitting agency to a transmission destinationa circuit state distinguishes a good course and the course which carries out data transfer is determined in the wireless network which transient abnormalities tend to generateStable radio with little accident discontinuation can be realizedthe reliability of a wireless network is improvedand application to a large scale network is enabled. Since a shortest-processing-time course or the course of the minimum circuit load can be chosenthe processability of data transfer can be improved.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The lineblock diagram of the radio device by one example of this invention.
[Drawing 2]The lineblock diagram of the wireless network which applies this invention.
[Drawing 3]The lineblock diagram of the frame by two or more examples used for the radio of this invention.
[Drawing 4]The flow chart of the course investigation frame in a wireless network (the 1).
[Drawing 5]The flow chart of the course investigation frame in a wireless network (the 2).
[Drawing 6]The flow chart of the course investigation frame in a wireless network (the 3).
[Drawing 7]The flow chart showing the procedure of the retry time numerical value in the course investigation frame by the radiocommunication control device of drawing 1.
[Drawing 8]The flow chart showing processing of the circuit load value in the course investigation frame by the radiocommunication control device of drawing 1.
[Drawing 9]The explanatory view showing the example of a circuit abnormal occurrence in the wireless network under communication.
[Drawing 10]The flow chart of the data frame for detecting the circuit abnormal occurrence under communication.
[Description of Notations]
100110120130140 -- A radiocommunication control device101-103121-123 -- Radio terminal200 [-- Band pass filter] -- A control section201 -- A timer202 -- A demodulator203 204 -- A receiving mixer205 -- A frequency synthesizer206 -- Transmission mixer207 [-- Transceiver changeover switch] -- A modulator208 -- A transceiver buffer209 -- An antenna210 211 [-- A transmission source address303 / -- A route304 / -- Data305 / -- CRC306 / -- Retry time307 / -- Circuit load.] -- A circuit malfunction detection threshold storage part300 -- A

preamble301 -- A transmission destination address302